Original Article

The Outcomes of Surgical Treatment of Recurrent Lumbar Disk Herniation with Discectomy Alone and Discectomy with Posterolateral Interbody Fusion

Hossein Nayeb Aghayee*, Shirzad Azhari, Farshad Heidarnejad

Department of neurosurgery, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Abstract

Background: Recurrent lumbar disk herniation (RLDH) is one of the major causes of failure of standard discectomy. The optimal treatment method for RLDH is controversial. In the current study, we aimed to compare the clinical and functional outcomes of treating RLDH with discectomy alone and discectomy associated with posterolateral interbody fusion (PLIF).

Material and Methods: There were 41 patients with RLHD after primary discectomy in the current retrospective study. Patients were assigned to 2 groups based on the surgical method: discectomy alone (17 patients) and discectomy with PLIF (24 patients). At the final visit the following variables were measured and compared between groups: the back and radicular pain intensity using visual analogue scale (VAS), functional outcome using oswestry low back pain disability scale (ODI), return to previous work and complication. Patients were followed for 13.9±2.8 and 15±3 months in discectomy alone and discectomy with PLIF groups, retrospectively.

Results: Complete fusion was achieved in 24 patients of PLIF group. The back pain intensity was the same; however the radicular pain intensity was significantly lower in PLIF group (1.5±0.9 V.s 2.3±1; p=0.017). Also, the mean of ODI scale was the same. 82.3% of patients in discectomy group and 87.5% of patients in PLIF group returned to previous work and the difference was not significant. One patient in discectomy group and 2 patients in PLIF group developed temporary neurological deficit which disappeared after 3 months.

Conclusions: Although both discectomy alone and discectomy with PLIF were associated with favorable mid-term results in treating patients with RLDH, however, the authors recommend using discectomy with PLIF for lower radicular pain.

Key Words: RLHD, PLIF, Discectomy

***Corresponding Author:** Hossein Nayeb Aghayee. Department of neurosurgery, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Please cite this article as: Nayeb Aghayee H, Azhari S, Heidarnejad F. The Outcomes of Surgical Treatment of Recurrent Lumbar Disk Herniation with Discectomy Alone and Discectomy with Posterolateral Interbody Fusion. Novel Biomed 2014;2(1):10-17.

Introduction

Disc prolapse surgery focuses on decompression of involved neurological root and at the time retaining stabilizing ligamentous and bony structures [1]. Since Barr and Mixter in 1934 discovered the relationship between Sciatica and Lumbar disc herniation (LDH) [2], it has been more than 50 years that standard discectomy is being used as the main treatment for LDH around the world [3]. Despite great developments in technology and medical science, this method is

preferred among many spine surgeons and several reports have been presented on their optimal results [2-4]. Although optimal and successful results of classical LDH surgeries are reported in the range of 88%-96.5% [2, 5], the surgery fails in some patients and problems such as RLDH and increasing back pain or sciatica have sometimes been reported [6]. Several studies have reported failures of this treatment method between 3-20% [4-8]. In this situation which is referred to as Failed back surgery syndrome, surgery does not alleviate the pain. The main reasons for failure of surgical decompression (SD) include: inappropriate diagnosis, false selection of patient, insufficient decompression, recurrent LDH at the same scale already applied or at a different level, epidural fibrosis, trauma in neurological roots during surgery, insufficient removal of disc old tissue, tumor, Spondylolisthesis, polyneuropathy, Arachnoiditis, facet joints arthritis, spinal canal stenosis and segmental instability [9,10]. After primary discectomy, RLDH is the main cause of pain and inability in 4-78% of cases [4, 7, 10-14]. However, it intensifies over time [3, 15, 16]. Actually, after a period without pain when SD was performed, Sciatica returns and one case to be considered in such cases is probability of RLDH occurrence. Although intensive studies have been conducted on the causes of failed back surgery syndrome, a few have examined patients with RLDH and in spite of introducing different treatment methods no superior treatment has been recognized so far and there are disagreements on preference of repeat discectomy or discectomy with fusion [2-7, 12, 16-23]. Some authors believe that repeat discectomy may provide desirable results compared to primary SD [7, 24], but its complications are dramatic [16, 25-27]. Presence of a scar tissue makes repetition of SD problematic which may lead to dural tear or neuropathy [3, 4, 12, 16]. In addition, excision of posterolateral organs such as facet joints might increase probability of segmental instability [10, 21, 28]. On the other hand, some surgeons believe that fusion is essential for treatment of disc herniation to prevent from segmental instability [28]. Regarding high occurrence of RLDH after initial discectomy and lack of consensus on a superior method for treatment of these patients, in the current study we have compared the results of treatments using discectomy alone and discectomy with posterolateral interbody fusion (PLIF).

Materials and Methods

In this retrospective study, patients with RLDH already gone under recurrent discectomy alone or discectomy with PLIF at Imam Hossein Hospital were investigated. Requirements for inclusion in this study involved: low back pain with radicular and intractable pain in legs, prior discectomy due to LDH, being in age group of 20-65 years old, painless periods for at least 6 months, and alleviation of other symptoms after initial surgery and LDH at the same level (ipsilateral or contralateral) verified using MRI and then in the course of surgery. By recurrent disc herniation we mean herniation at the same level of prior surgery and to this respect, occurrence of ipsilateral or contralateral herniation was not effective. Also, the same level of herniation must be verified by MRI or during surgery. Patients with Cauda Equine syndrome, low back pain without sore in legs, spinal canal stenosis with reduced walking distance, neurologic symptoms, inflammatory diseases, prior rupture in spines, generalized disc degeneration during radiography, extensive myofascial pain, herniation at a different level, and patients with prior records of surgery in spine other than those with primary discectomy at the same level and with surgery due to multilevel herniation, were excluded. We first referred to the archives of the respective hospital and files related to patients with a single discectomy surgery due to recurrent lumbar disc herniation were extracted. Then, we contacted the patients and asked them to refer to the hospital if they would. According to surgical methods, patients were divided into two groups: one with recurrent discectomy at the same level and the other with posterolateral interbody fusion in addition to discectomy at the prior level. Upon the final visit, patients carefully went under clinical and radiological examinations and their demographic and background information was recorded based on observations and their files. This information included age, gender, herniation level and its direction, recurrent symptoms mechanism, duration of symptoms alleviation, pain after primary operation and recurrence of symptoms. Radiological examinations upon the final visit included simple radiology from posteroanterior, lateral, flexion and extension profiles which was

measured using lateral radiography of interbody disc height. Severity of herniation was determined using MRI before operation according to the disc form as follows:

Protrusion: in this form, nucleus is protruded but annulus is natural and sound.

Extrusion: disc contents are projected through a rupture in annulus but they are still associated with disc space.

Sequestration: disc contents are freely present within the canal space away from disc space.

In final examination, clinical and functional statuses of patients were determined using Oswestry low back pain disability [16]. The patients were also asked about their ability to return to previous activities; their pain and satisfaction degrees were determined using Visual Analogue Scale. It is worthy of mention that clinical examinations were performed and individual assessment forms were filled without information on treatment method. Radiography in posteroanterior, lateral, flexion and extension profiles was applied to check for fusion. The standard for successful fusion included lack of movement and lucency of flexion or extension profiles. Finally, according to the available data in patients' files, any implication whether at the time of operation or after that was recorded.

SPSS ver.16 statistical software was used for data analysis. In order to compare intergroup quantitative data, in cases where the data followed normal distribution, independent t-test was used. Otherwise, nonparametric Mann-Withney U test was applied. For comparison of qualitative data, Chi-square and Fischer's tests were used. In current study, $p<0.05$ was regarded as significance level.

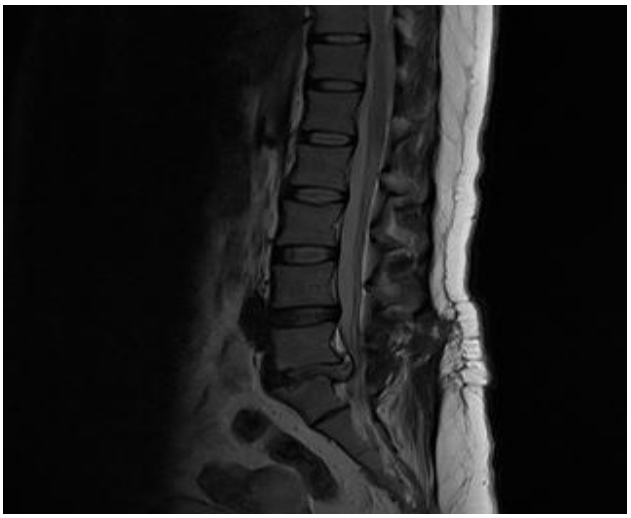
Results

Within 2008-2011, a total of 43 patients with RLDH had gone under surgery, two of whom avoided attending this study. As such, 41 patients with RLDH who had gone under operation were studied. Of these patients, 17 were included into recurrent discectomy group and 24 subjects were placed in the group with discectomy with PLIF. Demographic and background data for the patients have been compared in table 1. As you observe, there is no significant difference between the two groups.

Table 1- Comparison of demographic and background data for patients under study

	Recurrent discectomy (n=24)	Discectomy +PLIF (n=17)	p-value
Age(year)	**45/7±7/2**	**42/2±7/2**	0/156
Gender (%) **Male** **Female**	 **76/5(13)** **23/5(4)**	 **70/8(17)** **29/2(7)**	0/736
Herniation level **L2-L3** **L3-L4** **L4-L5** **L5-S1**	 **0** **5/9(1)** **76/5(13)** **17/6(3)**	 **8/3(7)** **8/3(2)** **79/2(19)** **4/2(1)**	0/339
Recovery period after primary surgery (month)	**12±4/2**	**11/5±3/8**	0/791
The interval between recurrence of symptoms and the patient's recourse (month)	**2/2±1/3**	**2/3±1/2**	0/64
Follow-up duration (month)	**13/9±2/8**	**15±3**	0/214

A



B

Figure 1: (A) Recurrent disc extrusion of L5-S1seen in sagittal T2 weighted
(B) Posterolateral interbody fusion (plif) of L5-S1 in the same patient

We compared the degree of low back pain with radicular pain between both groups and observed that low back pain does not show significant difference (1.7±1.2 in discectomy alone group versus 1.8±0.9 in discectomy + PLIF group; P= 0.697). While radicular pain in discectomy+ PLIF group was significantly less than that of discectomy alone (2.3±1) (p= 0.017), comparison of ODI scores between both groups indicated that there is no significant difference between them (30.5±3.3 in discectomy alone versus 29.3±2.6 in discectomy+ PLIF group; p=0.199). In discectomy alone, 82.3% of patients (14 subjects) and in discectomy+ PLIF, 87.5% (21 subjects) stated that they have the ability to return to prior activities, however, there wasn't statistical significant difference between these two groups (p=0.679). In discectomy alone group, one patient (5.9%) and in discectomy+ PLIF group, 2 patients (8.3%) suffered from neurological deficit (a decrease in distal force of unilateral organ) who recovered over time and after performing suitable rehabilitation. In this case study, no occurrence of DVT or sphincter dysfunction was observed and only one patient in discectomy+ PLIF group had infection which was treated by debridement surgery, washing and antibiotics. However, the difference between the two groups was not significant in terms of surgery-related complications. In discectomy+ PLIF group, full fusion was observed in all patients. Average duration of fusion was determined to be 23.6±4.2.

Discussion

The most important finding of the current study was that performing recurrent discectomy or discectomy+ PLIF for treating patients with RLDH already gone under discectomy was consistent with desirable clinical and functional results. We should note that performing PLIF with discectomy plays a critical contribution in alleviation of radicular pain and in this group radicular pain was significantly lower than that of discectomy alone. Lumbar disc herniation is among the main causes of referral to brain and neurological surgical centers and annually many patients suffering from pain, disability and acute disorders in daily activities arising from disc herniation go under operations. Although discectomy showed desirable results in treatment of these patients [2, 5], unfortunately the symptoms of the disease can recur and treatment may fail, in that case, one of the main causes of this problem is considered to be recurrent disc herniation [4, 7, 10-14]. Though this problem is a major challenge for spinal surgeons, a suitable and preferred treatment method has not been recognized yet. Some surgeons believe that recurrent discectomy leads to desirable outcomes [24]. Some others do not limit to it and believe that in RLDH surgery, in addition to discectomy, fusion is also essential [28]. The variety of related work and treatment methods to this respect and differences in their results has led to confusion and disabilities in decision-making. Moreover, different methods in designing the studies conducted so far are a critical factor in the existing inconsistencies, making decisions about suitable treatment method more difficult.

Investigating the outcomes of discectomy in treatment of primary herniation and RLDH, Acharya et al, remarked that discectomy is a safe and successful method, the results of which are satisfactory in 96.5% of primary herniation cases and in 78.6% of recurrent herniation cases. No cases of nerve root avulsion or infection was observed in this study. However, in

21.4% of patients, post-surgery unwanted complications including dura rupture were observed in two patients and improper exploration of the engaged area in one patient [2]. In another study, Cinotti et al, dealt with the outcomes of discectomy for treatment of patients with recurrent radicular pain after primary discectomy and observed that treatment results were satisfactory in 81% of patients. They also expressed that there is no association between epidural fibrosis size and surgical results [5]. Dai et al, similarly, investigated the outcomes of discectomy in patients suffering from RLDH who already had experienced discectomy operation. In this study, 39 patients with typical sciatica symptoms participated. The interval between primary operation and recurrence of symptoms differed from 6 months to 17 years. The average follow-up duration among these patients was 7 years and 8 months. During the final visit, we observed that the average JOA increased from 12 to 24 and improvement degree varied between 29% to 100% (mean:72%). 29 patients showed the ability to return to their previous work and normal activities, 7 patients showed dramatic improvement and 3 patients needed to take non-allergic medications. Dai et al. concluded that discectomy results are satisfactory for RLDH treatment. They stated that factors such as gender, age, traumatic events, the interval from the past surgery, herniation level, herniation direction, duration of recovery from primary surgery, duration of appearance of recurrent symptoms, ability to walk, pre-surgery JOA score, spinal canal stenosis, and dura rupture played any role in the results (6).

In another study, Guo et al. examined the long run outcomes of lumbar open discectomy with fenestration where 51 patients had gone under open discectomy at the initial level for the second time and on average, they were followed for 147 months. Researchers observed that according to Macnab classification, 70.6% of patients obtained good results and 78.4% of them were satisfied with the results. Treatment in 8 patients (15.7%) failed. The average improvement using JOA and without considering 8 patients who needed revision surgery, was 64.6%. Side effects were observed in 5 patients (13.9%) with good results (2 cases of dura rupture, 2 cases of nervous root damage and 1 case of deep infection) and 3 patients whose treatment had failed (3 cases of dura rupture). Guo et al. listed the factors affecting the relatively good and bad results: smoking, trauma, fibrosis, and duration of recurrent symptoms. These authors expressed that psycho-social problems are probably associated with occurrence of undesirable results. In the end, they suggested that as Revision surgery is followed by more complicated problems, careful selection of patients is very effective in final outcomes [3]. Similarly, Tsai et al. investigated the results of revision discectomy for RLDH treatment and observed that according to Macnab classification, satisfactory results were obtained in 82% of patients. They found out that 79% of patients had no complaints for post-surgery radicular pain. In this study, 2 cases had dura ruptures which were repaired during operation [12]. Morgan- Hough et al. in treating 42 patients with Sciatica pain after revision discectomy observed that 8 patients (19%) suffered from unwanted complications including 7 cases of dura rupture followed by CSF leak and one case of pulmonic infection. Among the 7 patients with dura rupture, one of them was afflicted with Pseudomeningocele [4]. Suk et al. also found desirable results of RLDH treatment with revision discectomy and recommended this treatment technique [7].

On the other hand, Brox et al. compared one-year results of transpedicular fusion with cognitive treatments in patients with post-surgery chronic low back pain to treat lumbar disc herniation. They found out that ODI score in the fusion and cognitive treatment groups reduced respectively from 47 to 38 and 45 to 32. Treatment success for these groups was 50% and 48%, respectively. Brox et al. finally stated that fusion is not superior to non-surgical treatments. In their study, only two patients had superficial wound infections and no other complications were observed [20].

In another study, Chen et al. investigated RLDH treatment results by discectomy+ TLIF (transforminal lumbar interbody fusion) in 43 patients and observed that the average JOA score after surgery increased from 9.3 to 25.They also found that average improvement was 86%. Clinical results in 23 cases were very good and in 6 cases were fairly good and fusion was achieved in all patients. Two patients had

dura rupture and none showed CSF leak. One patient showed superficial surgical wound infection. In this study, 3 patients experienced neurological deficits which disappeared after 3 months and no other significant complication was observed. Finally, these authors concluded that TLIF technique can be beneficial in treatment of RLDH [16]. Niu et al, investigating the results of RLDH treatment by discectomy with Single cylindrical threaded cage on the intact side of spine in 14 patients, observed no cases of dura rupture or neurological deficit. However, three patients experienced superficial wound infection and urinary tract infections. One patient also got asymptomatic disk wedging. Finally, these researchers stated that successful fusion was achieved in 12 patients (85.8%) while in 2 other patients, interbody fusion failed. Generally, Niu and coworkers observed that clinical results were satisfactory in 13 patients (92.9%) [19].

As it can be seen, reviews of results from previous studies were confusing and ambiguous. However, we must be careful that most of these studies have been descriptive and have addressed just one group of patients. It is obvious that this kind of study cannot provide us with appropriate insights into selection of treatment methods. Although the levels of success in such studies have been reported 70% to around 90%, we must considerate that this level of failure in treatment is not a promising result and a large number of patients will experience even more acute problems. Many of them accept more operations while consequences of previous surgeries make the revision surgeries more difficult. For this reason, comparative studies in which different RLDH treatment methods are clinically, biomechanically and radiologically compared are critical and essential. As far as we know, there are limited studies to this respect, two of which we here refer. Fu and coworkers, for example, investigated long term results (on average 88.7 months) of discectomy with and without posterolateral fusion (PLF) to treat RLDH in 41 patients. According to JOA standard, clinical results were obtained in 78.3% of patients without PLF and 83.3% of those with PLF. Generally, improvement was 82.2% and the difference between those with and without PLF was not significant. Likewise, the difference in terms of post-surgical low back pain was not significant. However, blood loss during surgery, duration of surgery and duration of confinement to hospital bed was significantly lower in the patients without PLF than in those with it. Fu et al. ultimately concluded that revision surgery is effective and suitable for treatment of recurrent sciatica in cases where the patient is suffering from recurrent disc herniation. These authors recommended discectomy without fusion [17]. Similarly, Zhuo and coworkers compared the results of RLDH treatment using three methods of revision discectomy (25 patients, group A), PLIF (22 patients, group B) and TLIF (18 patients, group C). They found that on-surgery complications in groups A (24%) and B (22.3%) were significantly higher than those in group C (5.6%) but there wasn't a significant difference between A and B. There wasn't significant difference among the three groups in terms of confinement to hospital bed. During the first week after surgery, satisfaction in group A was 84%, 81.8% in group B and 88.9% in group C. Fusion in all patients of groups B and C was successful. There was no significant difference among the groups in terms of improvement in VAS and ODI. Intervertebral space height after surgery increased significantly in group A and significantly decreased in the two other groups. These researchers concluded that all three treatment methods are effective for RLDH treatment but discectomy and PLIF lead to large numbers of side effects. They also suggested that discectomy is accompanied by a decrease in intervertebral space and consequent probability of segmental instability while TLIF is an ideal, safe and effective method for treatment of RLDH [18]. Along with these two contradictory studies, one supporting discectomy alone and the other supporting discectomy+ TLIF, we conducted our retrospective study in which 41 patients dominantly with recurrent herniation at L4-L5 level and observed that over mid-term follow up, both methods gave relatively desirable and similar clinical and functional results. The main point was that our subjects of study were in two groups with similar backgrounds so there wasn't any significant statistical difference among them. In our study, the majority of patients restored their ability to

return to previous activities and undesirable complications were trivial. Significant complications in this study included 3 cases of temporary neurological deficits (one patient in discectomy alone and two patients in discectomy + PLIF) all of whom improved over time. Functional results were similar and acceptable according to ODI. Complete fusion was achieved in all PLIF patients. We also observed that after surgery and upon the final visit, the severity of low back pain was the same in both groups. The only statistically significant finding in this study was that the severity of radicular pain in the group who went under fusion was significantly lower than that of the discectomy group. It seems that this finding results from the ability of fusion in preventing from segmental instability or reduction of intervertebral space and stress on the nerve root which can be an important factor for selection of the preferred method. It is possible that in long term follow ups in future, this condition progresses and radicular pain in discectomy alone increases. However, more studies are needed to clarify the issue. It must be noted that in the past, some authors have talked about the risk of segmental instability after discectomy due to incision of posterior organs such as facet joints and have suggested that fusion may play a significant contribution in preventing from this effect [21, 10, 28]. This finding can confirm our results. Current study like all other ones bears some limitations. The main problem of this study was that it was retrospective and we were not able to incorporate surgery conditions with previous status assessments of patients. In addition, we investigated the results in mid-term.

Conclusion

According to the findings of the current study in which the midterm results of RLDH treatment after primary discectomy, discectomy alone and discectomy + PLIF are the same in terms of function, low back pain, the degree of return to prior activities and complications, discectomy + PLIF is recommended due to significant alleviation of radicular pain in this group.

References

1. Mixter WJ, Barr JS. Rupture of the intervertebral disc with involvementof the spinal canal. N Engl J Med 1934;211:210-4.
2. Acharya KN, Nathan TS, Kumar JR, Menon KV.Primary and revision lumbar discectomy: a three-year review from one center. Indian J Orthop 2008;42(2):178-81.
3. Guo JJ, Yang H, Tang T. Long-term outcomes of the revision open lumbar discectomy by fenestration: A follow-up study of more than 10 years. Int Orthop 2009;33(5):1341-5.
4. Morgan-Hough CV, Jones PW, Eisenstein SM.Primary and revision lumbar discectomy. A 16-year review from one centre. J Bone Joint Surg Br 2003;85(6):871-4.
5. Cinotti G, Roysam GS, Eisenstein SM, Postacchini F. Ipsilateral recurrent lumbar disc herniation. A prospective,controlled study. J Bone Joint Surg Br 1998;80:825-32.
6. Dai LY, Zhou Q, Yao WF, Shen L. Recurrent lumbar disc herniation after discectomy: outcome of repeat discectomy. Surg Neurol 2005;64(3):226-31.
7. Suk KS, Lee HM, Moon SW, Kim NH. Recurrent lumbar disc herniation: Results of operative management. Spine 2001;26:672-6.
8. Fritsch EW, Jürgen H, Stefan R. The failed back syndrome: Reasons, intraoperative findings and long term results: A report of 182 operative treatments. Spine 1996;21:626-33.
9. Liaropolous K, Spiropoulou P, Papadakis N, Maraziotis Th, Korovessis P. Recurrence of sciatica following hemilaminectomy for disc herniation. Eur J Orthop Surg Traumatol 2003;13:235-40.
10. Ozgen S, Naderi S, Ozgen MM , Pamir MN. Findings and outcome of revision lumbar disc surgery. J Spinal Disord1999;12:287-92.
11. Ambrossi GL, McGirt MJ, Sciubba DM, Witham TF, Wolinsky JP, Gokaslan ZL, et al. Recurrent lumbar disc herniation after single-level lumbar discectomy: incidence and health care cost analysis. Neurosurgery 2009;65(3):574-8.
12. Tsai C-H, Hsu H-C, Chen Y-J, Lin C-J, Chen H-T. Recurrent lumbar disk herniation after discectomy: clinical results of repeated discectomy and analysis of factors affecting surgical outcome. Mid Taiwan J Med 2007;12:125-32.
13. Hao Y, Deng S, Li J, Ma Y. Using of transforaminal lumbar interbody fusion in lumbar revision surgery. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2011;25(1):87-90.
14. Swartz KR, Trost GR. Recurrent lumbar disc herniation. Neurosurg Focus2003;15(3):E10.
15. Gaston P, Marshall RW. Survival analysis is a better estimate of recurrent disc herniation.J Bone Joint Surg Br 2003;85(4):535-7.
16. Chen Z, Zhao J, Liu A, Yuan J, Li Z. Surgical treatment of recurrent lumbar disc herniation by transforaminal lumbar interbody fusion. Int Orthop 2009;33(1):197-201.
17. Fu TS, Lai PL, Tsai TT, Niu CC, Chen LH, Chen WJ. Long-term results of disc excision for recurrent lumbar disc herniation with or without posterolateral fusion. Spine (Phila Pa 1976) 2005;30:2830-4.
18. Zhuo X, Hu J, Li B, Sun H, Chen Y, Hu Z. Comparative study of treating recurrent lumbar disc protrusion by three different surgical procedures. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2009;23(12):1422-6.
19. Niu CC, Chen LH, Lai PL, Fu TS, Chen WJ. Single cylindrical threaded cage used in recurrent lumbar disc herniation. J Spinal Disord Tech 2005;18 Suppl:S65-72.
20. Brox JI, Reikerås O, Nygaard Ø, Sørensen R, Indahl A, Holm I, et al. Lumbar instrumented fusion compared with cognitive intervention and exercises in patients with chronic back pain after previous surgery for disc herniation: a prospective randomized controlled study. Pain 2006;122(1-2):145-55.
21. Shin KH, Chang HG, Rhee NK, Lim KS. Revisional percutaneous full endoscopic disc surgery for recurrent herniation of previous open lumbar discectomy. Asian Spine J 2011;5(1):1-9.

22. Deyo RA, Weinstein JN. Low back pain. N Engl J Med 2001;344:363-70.
23. Baba H, Chen Q, Kamitani K, Imura S, Tomita K. Revision surgery for lumbar disc herniation. An analysis of 45 patients.IntOrthop1995;19:98-102.
24. Papadopoulos EC, Girardi FP, Sandhu HS, Sama AA, Parvataneni HK, O'Leary PF, et al. Outcomeof revision discectomies following recurrent lumbar disc herniation. Spine 2006;31:1473-6.
25. Keskimaki L, Seitsalo S, Osterman H, Rissanen P. Reoperations after lumbar disc surgery. Spine 2000;25:1500-8.
26. Silvers HR, Lewis PJ, Asch HL, Clabeaux DE. Lumbar discectomy for recurrent disc herniation. J Spinal Disord1994;7:408-19.
27. Herron L. Recurrent lumbar disc herniation: results of repeat laminectomy and discectomy. J Spinal Disord 1994;7:161-6.
28. Stolke D, Sollmann WP, Seifert V. Intra- and postoperative complications in lumbar disc surgery. Spine 1989;14:56-9.